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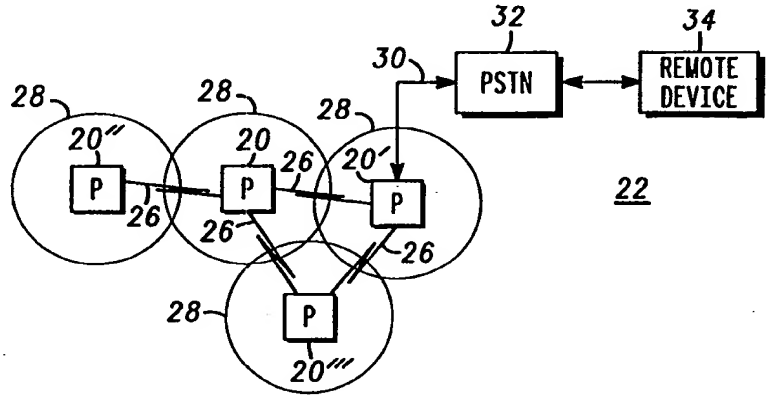

(57) Abstract

A wireless, peer-to-peer, capability addressable network (22) is disclosed. The network (22) accommodates any number of peers (20). Network connections are formed based upon proximity between peers (20) and upon a needs and capabilities evaluation (82). Networks (22) support three classifications of service capabilities: service requesting, service providing, and service relaying. Wireless communications occur at a sufficiently low power to form a detection zone (28) of less than five meters for many peers (20).

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CAPABILITY ADDRESSABLE NETWORK AND METHOD THEREFOR

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to data communication networks. More specifically, the present invention relates to a peer-to-peer network in which node addressing is dynamically configurable.

BACKGROUND OF THE INVENTION

In a typical day many people come into contact with a massive number of electronically controlled devices. Such devices range from automobiles and appliances, to home and office equipment, and to telephones and televisions to name but a few. Many of these devices are required to move from time to time, and many of these devices are even portable. These devices provide a vast and diverse assortment of services for the people coming into contact with them. However, they suffer from a common problem related to user input and output (I/O).

User I/O refers to components and processes used to communicate user-supplied data to an electronic device and to annunciate data from an electronic device so the data may be perceived by a user. Although electronic devices provide a vast and diverse assortment of services, they tend to have redundant I/O. In other words, many such devices have displays, speakers, and the like at which data may be annunciated and have buttons, switches, keypads, and other controls at which user-supplied data may be communicated to the devices. In order to keep costs low and size small, user I/O capabilities often suffer. As a result, many electronic devices encountered in everyday life, and particularly many portable devices, are cumbersome and tedious to use because communicating data from a user to the devices is difficult and because provisions are unavailable for clearly annunciating data for a user's benefit.

In theory, this user I/O problem could be ameliorated by better integrating electronic devices to ease data communications therebetween. For example, a portable telephone could receive a facsimile (fax), but typically has no capability to print the fax and typically has no capability to communicate with a printer which may be able to print the fax. Likewise, a pager may receive a call-back phone number, but typical pagers have no capability to transfer the call-back number to a telephone from which the call-back can be made. User involvement is required to address these and many other data transfer issues. While many conventional data communication or computer network architectures are known, the conventional architectures are unsuitable for the task of integrating a plurality of electronic devices which collectively provide a vast and diverse assortment of services.

Conventional computer networks require excessively complicated setup or activation procedures. Such setup and activation procedures make the jobs of forming a connection to a new network node and making changes in connectibility permission cumbersome at best. Setup and activation procedures are instituted, at least in part, to maintain control of security and to define network addresses. Typically, a system administration level of security clearance is required before access is granted to network tables that define the network addresses. Thus, in conventional networks, many network users lack sufficient security clearance to activate and obtain addresses of network nodes with which they may wish to connect on their own.

Once setup is performed, either directly by a user or by a system administrator, connections are formed when an initiating node presents the network with the address of a network node to which a connection is desired. The setup or activation requirements of conventional networks force nodes to know or obtain a priori knowledge of node addresses with which they wish to connect prior to making the connection. Excessive user attention is involved in making the connection through setup procedures and during the instant of connection

to obtain addresses. This level of user involvement leads to an impractical network implementation between the everyday electronic devices with which people come into contact.

Further, conventional computer networks tend to be infrastructure intensive. The infrastructure includes wiring, servers, base stations, hubs, and other devices which are dedicated to network use but have no substantial non-network use to the computers they interconnect. The use of extensive network components is undesirable for a network implementation between everyday electronic devices because an immense expense would be involved to support such an infrastructure and because it impedes portability and movability of nodes.

The use of wiring to interconnect network nodes is a particularly offensive impediment to the use of conventional networks because wiring between diverse nodes is not suitable when some of the nodes are portable. Wireless communication links could theoretically solve the wiring problem. And, conventional wireless data communication networks are known. However, the conventional wireless networks do little more than replace wire lines with wireless communication links. An excessive amount of infrastructure and excessive user involvement in setup procedures are still required.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the present invention may be derived by referring to the detailed description and claims when considered in connection with the Figures, wherein like reference numbers refer to similar items throughout the Figures, and:

FIG. 1 shows a layout diagram depicting exemplary relationships between various peers in a wireless peer-to-peer data communication network configured in accordance with the teaching of the present invention;

FIG. 2 shows a block diagram of hardware included in a peer;

FIG. 3 shows a list of appliance circuits which may be included in the hardware illustrated in FIG. 2;

FIG. 4 shows a list of gateways which may be included in the hardware illustrated in FIG. 2;

FIG. 5 shows a list of I/O devices which may be included in the hardware illustrated in FIG. 2;

FIG. 6 shows a flow chart of exemplary tasks included in a capability addressable connection process performed by a peer;

FIG. 7 shows a data format diagram of an exemplary need/capability message communicated from a peer to initiate a setup connection;

FIG. 8 shows an exemplary need table which identifies possible network service needs which might occur at a peer;

FIG. 9 shows an exemplary capability table which identifies possible network capabilities which may be provided by a peer; and

FIG. 10 shows an exemplary flow chart of a process service connection procedure performed at a peer.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a layout diagram depicting relationships between various peers (P) 20 in a capability addressable, wireless, peer-to-peer data communication network 22 configured in accordance with the teaching of the present invention. While FIG. 1 shows only a few peers 20, virtually any computer or microprocessor controlled electronic device throughout the world may serve as a peer 20. Accordingly, network 22 supports an unlimited number of possible connections between peers 20.

As used herein, the term "peer-to-peer" is defined to mean having at least common portions of communications protocol and/or capability and does not refer to equivalence of physical size, functional capability, data processing capacity or transmitter/receiver range or power. Each peer or communication node 20 of communications network 22 may establish a personal area network. For example, a first and a second of nodes 20 first find or determine that each other is a compatible node. Then, as a result of self-initiated processes, first and second nodes 20 form the personal

network. First and second nodes 20 must detect that they are in a particular proximity to one another and if so a communication link is established. This link may be accomplished by known RF, IR, optical or acoustic techniques, or by conduction through a living body. When a link is established, first and second nodes 20 exchange what their needs and capabilities are. When needs and capabilities are not able to be satisfied or matched, one of first and second nodes 20 may alternately route the communications link to a third communication node 20. Put another way, a communications platform that includes at least two nodes having overlapping communications regions could also include means for exchanging needs and capabilities information between the at least two nodes for forming a communication network.

Network 22 is desirably configured in a peer-to-peer architecture so that only a minimal number of network-specific components are used and no fixed infrastructure is required. In the preferred embodiments, each peer 20 can initiate a connection with other peers 20 without servers being required to manage the connections. Moreover, peers 20 can freely move about without affecting the network structure or requiring the performance of reconfiguration, setup, or activation procedures.

Free movement of peers 20 is further supported by using wireless communication links 26 as a physical transport layer in network 22. In the preferred embodiments, wireless communication links 26 are RF links operating in the higher regions of the microwave band so that small, lightweight, inexpensive, omni-directional antennas may be used. However, other RF frequencies, optical links, and other wireless communication links known to those skilled in the art may be used as well. The specific protocols used in implementing wireless communication links 26 are not important to the present invention. Various TDMA, FDMA, and/or CDMA techniques known to those skilled in the art may be employed. However, all peers 20 in network 22 desirably have the ability to

communicate using the protocols, regardless of the capabilities and needs of the peers 20.

FIG. 1 depicts a detection zone 28 surrounding each peer 20. In the preferred embodiments, wireless communication links 26 for the vast majority of peers 20 are operated at a sufficiently low power so that a wireless communication range for a given peer 20 is preferably less than 5 meters, although the range may be much greater, for the typical peer 20. The use of this degree of low power transmissions limits interference between independent connections which may share the wireless spectrum at different locations. Moreover, the use of this degree of low power transmissions is compatible with configuring a substantial portion of peers 20 as portable devices. Those skilled in the art will appreciate that hand-portable electronic devices share the characteristics of being physically small, lightweight, and including a self-contained power source such as a battery. Extremely low power transmissions do not severely deplete the reserves of small batteries typically used in portable devices.

While a peer 20 may potentially connect through network 22 with a vast multitude of peers 20, the use of low power wireless communication links 26 limits the number of potential connections at any given instant in time to those peers 20 which are physically proximate to one another. In other words, only when a first peer 20 resides in the detection zone 28 of a second peer 20 and that second peer 20 resides in the detection zone 28 of the first peer 20 can a connection through network 22 occur.

Rather than specifying a network unique address to initiate a connection, network 22 uses physical proximity along with a needs and capabilities evaluation (discussed below) to target a peer 20 with which a connection is desired. By not specifying a network unique address to initiate a connection, user involvement in making connections is reduced and network addressing becomes dynamically configurable. Such an addressing scheme is useful in exchanging data between devices a user carries and comes into contact with on a daily basis. Relaying information between peers not in direct

communication is also possible. For example, peer 20" may establish a communication link with peer 20'" via peer 20. In this case, peer 20 provides the relay interface between the other two peers.

Not all peers 20 are required to be portable devices. FIG. 1 shows a communication link 30, which may or may not include a wireline link, connecting a peer 20' to a public switched telecommunication network (PSTN) 32. Through PSTN 32, peer 20' may communicate with a vast assortment of remote devices 34, of which FIG. 1 shows only one. Peer 20' may be powered from a public power network (not shown) so that minimizing power consumption is not a significant design issue. While FIG. 1 depicts only PSTN 32 linking a peer 20 to a remote device 34, other local area network (LAN), wide area network (WAN) or communication links known to those skilled in the art may connect a peer 20 to remote devices 34. Remote devices 34 may or may not themselves be peers 20. While network 22 uses proximity as a factor in targeting peers 20 to which connections are formed, the use of routing, gateway or relaying peers 20' permits connections to be extended over great distances through the use of other networks.

FIG. 2 shows a block diagram of hardware included in a peer 20. Peer 20 includes an antenna 36 configured to support wireless communication link 26. Antenna 36 couples to a transmit and receive section 38. Transmit and receive section 38 is compatible with the protocols peers 20 use to communicate with one another. Transmit and receive section 38 couples to a processor 40. Processor 40 couples to a memory 42, an optional gateway 44, communication link 30, an optional I/O section 46, transmit and receive unit 38 and optional appliance circuits 48.

Processor 40 executes computer programs 50 which are stored in memory 42. Computer programs 50 define processes performed by processor 40 and peer 20. Memory 42 additionally stores personalization data 52 and application data 54. Personalization data 52 characterize a user or owner of peer 20 and may change from user to user. ID codes, passwords, and PINs are examples of personalization data as are radio or TV

channel presets, language preferences, and speed dial telephone numbers. Application data 54 are provided by performing peer applications, and may change from moment to moment. A facsimile, a telephone number received over a pager, data scanned in using a bar code reader, and a sound snippet received from a microphone or other audio source represent examples of application data.

In one embodiment, the present invention is realized as an integrated circuit for interactively coupling one or more communication nodes in a common network. The integrated circuit includes, in combination, a receiver for receiving input data, a transmitter for transmitting output data and a processor. The processor is coupled to the receiver and transmitter for interactively coupling a first common node to a second common node. The processor includes apparatus for activating a communications link between the first and second common nodes when the first and second common nodes are within a predetermined distance from each other and when needs and capabilities of said first and second common nodes overlap.

FIG. 3 shows a non-exhaustive list of examples of appliance circuits 48 which may be included in a peer 20. Referring to FIGs. 2 and 3, appliance circuits 48 may be configured as any type of a wide variety of everyday, commonly encountered electronically controlled devices, fixed or portable. Thus, a peer 20 may, in addition to being a peer 20, be a personal digital assistant (PDA), television, radio, CD player, tape player, copier, facsimile machine, telephone, cellular telephone, cordless telephone, pager, watch, computer, point of sale (POS) terminal, automated teller, or other electronic device.

FIG. 4 shows a non-exhaustive list of gateways 44 which may be included in a peer 20. Referring to FIGs. 2 and 4, gateways 44 may be configured as any of a wide variety of relay, routing, or protocol conversion devices known to those skilled in the art. For example, a peer 20 may, in addition to being a peer 20, be a modem which couples peer 20 to PSTN 32 (see FIG. 1). Other gateways 44 may couple a peer 20 to LANs or WANs. Still other gateways 44 may couple a peer 20

modem to a satellite, a peer 20 cell phone to PSTN 32, a plain old telephone (POT) peer 20 to PSTN 32.

FIG. 5 shows a non-exhaustive list of I/O devices 46 which may be included in a peer 20. Referring to FIGs. 2 and 5, I/O devices 46 may be classified into input devices and output devices. Input devices may include keyboards, pointing devices, optical scanners, microphones, and other well known input devices. Output devices may include printers, monitors, speakers, and other well known output devices. Thus, in addition to being a peer 20, a peer 20 may be an I/O device 46.

Those skilled in the art will appreciate that gateways 44, I/O section 46 and appliance circuits 48 are not mutually exclusive categories. For example, many devices fall into multiple categories. For example, a computer considered as an appliance may include both an I/O section and a gateway. Likewise, a gateway may serve an I/O role.

FIG. 6 shows a flow chart of tasks included in a capability addressable connection process 56 performed by a peer 20. Process 56 is defined by a computer program 50 stored in memory 42 of peer 20 (see FIG. 2) in a manner well known to those skilled in the art. In the preferred embodiments, all peers 20 perform a process similar to process 56.

Process 56 includes a query task 58 during which peer 20 determines whether a setup connection is being attempted. Generally, task 58 allows a first peer 20 to determine whether a second peer 20 is physically proximate to the first peer 20. Task 58 causes transmit and receive section 38 (see FIG. 2) to monitor wireless communication link 26 (see FIG. 1) to determine whether a signal compatible with a protocol being used by network 22 (see FIG. 1) can be received. Due to the above-described low transmission power levels used by peers 20, when a signal is detected, the peer 20 sending the signal is located near the receiving peer 20.

When task 58 fails to determine that a setup connection is being attempted, a query task 60 determines whether a connection-seeking event has occurred. A connection-seeking

event causes a peer 20 to seek out a connection with another peer 20. Connection-seeking events can be triggered using a periodic schedule. For example, connections may be sought out every few seconds. In this example, the schedule may call for more frequent periodic connection attempts from peers 20 which are powered from a public power network and less frequent connection attempts from peers 20 which are battery powered. Connection-seeking events can also be triggered upon the expiration of a fixed or random interval timer or upon the receipt of other external information. The other external information can include information obtained through appliance circuits 48, gateway 44, or I/O section 46 (see FIG. 2) including user input.

If task 60 fails to determine that a connection-seeking event has occurred, program control loops back to task 58. If task 60 determines that a connection-seeking event has occurred, process 56 performs a task 62. Task 62 initiates an unsolicited setup connection. The setup connection is not addressed to any particular peer 20 of network 22. Rather, it is broadcast from the peer 20 making the attempt and will be received by all peers 20 within the detection zone 28 (see FIG. 1) of the broadcasting peer 20. As discussed below, the broadcast signal need not be answered by another peer 20 even when another peer 20 is in detection zone 28. At this point, the broadcasting peer 20 need not know if any other peer 20 can receive the broadcast signal, and the broadcasting peer 20 may or may not know any particular needs or capabilities of other peers 20 should other peers 20 be sufficiently proximate so that a connection may be formed.

Task 62 initiates a setup connection by broadcasting a need/capability message 64, an exemplary format for which is depicted in FIG. 7. Referring to FIG. 7, message 64 includes an ID 66 for the peer 20 broadcasting message 64, an authorization key 68, a need specification 70, a capability specification 72, and can include other data elements. ID 66 is desirably sufficiently unique within the domain of network 22 so that it may be used in an addressed service connection, should the setup connection prove successful. Authorization

key 68 includes one or more data codes which may be used by a receiving peer 20 in performing an authorization process. Needs specification 70 is a list of network needs currently experienced by the broadcasting peer 20. Capability specification 72 is a list of network capabilities which the broadcasting peer 20 may provide to other peers 20 of network 22.

Needs specification 70 may be determined by consulting a need table 74, an exemplary and non-exhaustive block diagram of which is depicted in FIG. 8. As illustrated in FIG. 8, data codes may be associated with a variety of network service needs which a service-requesting peer 20 may experience.

One exemplary need is that of appliance personalization. In the appliance personalization need example, a PDA might need to personalize nearby appliances. To satisfy this need, personalization data 52 (see FIG. 2) should be programmed into certain nearby appliances without user intervention. As a result, the certain appliances will always be programmed with a particular user's personalization data whenever that user is near, without requiring action on the user's part, and regardless of prior persons who may have used the appliance.

Other exemplary needs can include that of printing application data 54 (see FIG. 2), displaying application data 54, annunciating application data 54 at a speaker, routing connectivity to the Internet or other network resources, POS transactions, passage through secure areas or toll booths, and the like.

Capability specification 72 may be determined by consulting a capability table 76, an exemplary and non-exhaustive block diagram of which is depicted in FIG. 9. As illustrated in FIG. 9, data codes may be associated with a variety of network capabilities provided by a service-providing peer 20. For example, a service-providing peer 20 capability can be that of appliance personalization. Thus, a peer 20 may be capable of being personalized by personalization data 52 (see FIG. 2). Other examples include capabilities of printing, displaying, annunciating over a speaker, relaying a connection through the Internet or other

network or POS terminal, and unlocking a secured passageway, to name a few. In general, potential capabilities are compatible with potential needs.

Referring back to FIG. 7, need/capability message 64 includes those codes from tables 74 and 76 (see FIGs. 8-9) that currently apply. While a peer 20 may have more than one need or capability at a given instant, nothing requires a peer 20 to have multiple needs or capabilities. Moreover, nothing requires a peer 20 to have both a network need and a network capability. Message 64 serves as a need message if a peer need is specified regardless of whether a peer capability is specified and as a capability message if a peer capability is specified regardless of whether a peer need is specified.

Referring back to FIG. 6, after task 62 broadcasts message 64 (see FIG. 7), program control loops back to task 58.

When task 58 eventually detects that a setup connection is being attempted by receiving a message 64, a task 78 performs an authorization process. Task 78 uses authorization key 68 (see FIG. 7) from message 64 to determine if the peer 20 attempting to setup a connection is authorized to connect to the receiving peer 20. Task 78 allows an owner of a peer 20 to restrict access to the owned peer 20 through network 22. The authorization process of task 78 may be used, for example, to restrict personalization capabilities of an appliance to a small family group. Alternatively, a peer 20 having a POS capability may perform an extensive authorization process before permitting a transaction to take place. A peer 20 having a need may also qualify the receipt of provided services depending upon the authorization process provided by task 78.

After task 78, a query task 80 determines whether the authorization process 78 authorized the attempted setup connection. If authorization is denied, program control loops back to task 60. The receiving peer 20 need not reply or otherwise acknowledge the attempted setup connection.

If authorization is accepted, a task 82 evaluates peer needs with peer capabilities. In other words, task 82 causes the message-receiving peer to compare its available

capabilities (if any) to any needs listed in a received unsolicited need/capability message 64 (see FIG. 7) and to compare its available needs (if any) to any capabilities listed in the message 64. After task 82, a query task 84 acts upon the result of the evaluation of task 82. If no internal capabilities match needs indicated in an unsolicited message 64, and if no internal needs match capabilities indicated in an unsolicited message 64, then neither peer 20 can be of service to the other. Program control loops back to task 60, and the receiving peer 20 need not reply or otherwise acknowledge the attempted setup connection.

At this point, the vast multitude of potential connections which a peer 20 may make within network 22 has been greatly reduced in scope without the use of network-unique addressing. The low power transmission scheme excludes most peers 20 in network 22 from being connectable at a current instant because most peers 20 will not be proximate one another. Of the few peers 20 which may be within each other's detection zones 28 (see FIG. 1), the scope of potential connections has been further limited through the authorization process of task 78 and needs and capabilities evaluation of task 82. Additional exclusions on the remaining potential connections are performed through a negotiation process carried on between a service-requesting peer 20 and a service-providing peer 20.

When task 84 determines that capabilities and needs appear to be compatible, a query task 86 determines whether this negotiation process is complete. If the negotiation process is not complete, a task 88 establishes or otherwise continues the setup connection in furtherance of the negotiation process by sending an addressed negotiation message (not shown) to the peer 20 whose peer ID 66 (see FIG. 7) was included in a just-received needs/capabilities message 64. The negotiation message can have a form similar to that of needs/capabilities message 64, but be specifically addressed to the other peer 20.

After task 88, program control loops back to task 60. Subsequent negotiation messages may, but need not, be received. If such subsequent negotiation messages indicate

that both peers 20 to the prospective connection have completed negotiation, a query task 90 determines whether the negotiation was successful. If the negotiation was not successful, program control loops back to task 58, and no service connection will result. However, if the negotiation was successful, a process service connection procedure 92 is performed. During procedure 92, a one-to-one, addressed connection is established between peers 20 to perform network services. Upon completion of the service connection, program flow loops back to task 58.

While nothing prevents capability addressable connection process 56 from relying upon user intervention during the setup connection process, user intervention is not required. Whether user intervention is required or not should depend upon the security, a priori knowledge and other considerations connected with the nature of the peers 20 involved. For example, peers 20 involved in financial transactions can benefit upon user intervention to ensure security. However, personalization of user-owned appliances and many other connection scenarios need not rely on user intervention.

FIG. 10 shows a flow chart of process service connection procedure 92. Procedure 92 illustrates a collection of tasks which can be performed at a service-providing peer 20 in support of a service connection. Not all peers 20 need to be able to perform all the tasks depicted in FIG. 10. Likewise, many peers 20 may include other tasks which suit the nature of those particular peers 20.

Procedure 92 performs a task 94 to provide a network relay, router, or gateway capability for a service-receiving peer 20 of network 22 through an established service connection. During task 94, a service-providing peer 20 relays data communications between the connected peer 20 and a remote device 34 (see FIG. 1). After task 94, program flow returns to process 56 (see FIG. 6). Task 94 may be used to extend the service connection to the Internet or other network.

Procedure 92 performs tasks 96 and 98 to provide a user input capability for a service-receiving peer 20 of network 22

through an established service connection. During task 96, the service-providing peer 20 collects user input from its I/O section 46 (see FIG. 2). During task 98, the service-providing peer 20 sends the collected user input data to the connected service-receiving peer 20. After task 98, program flow returns. Tasks 96 and 98 may be used to control or program appliances from a PDA or other device which may have enhanced user input capabilities.

Procedure 92 performs a task 100 to provide a user output capability for a service-receiving peer 20 of network 22 through an established service connection. During task 100, the service-providing peer 20 receives data generated from the service-receiving peer 20 over the service connection and annunciates the data at an output device in its I/O section 46 (see FIG. 2). The data may be annunciated in an audibly or visibly perceivable format or in any other format perceivable by human senses. After task 100, program flow returns. Task 100 may be used to annunciate data collected in a portable peer 20 at a non-portable annunciating device. Alternatively, task 100 may be used to annunciate data generated by a stationary appliance with limited I/O capability at a portable annunciating device.

Procedure 92 performs a control appliance process 102 to support the controlling of appliances. Tasks 104, 106, and 108 of process 102 are performed to program an appliance peer 20 with personalization data 52 (see FIG. 2). During task 104, a service-providing peer 20 gets personalization data 52 from the connected, service-receiving peer 20 using the service connection. Next, task 106 translates the network compatible personalization data 52 into a format suitable for the specific appliance to be programmed with personalization data 52. Those skilled in the art will appreciate that not all personalization data 52 available in a service-receiving peer 20 need to be applicable to all appliances. Thus, task 106 can use as much of personalization data 52 as applies to the specific appliance. After task 106, task 108 causes the appliance to be programmed with the translated personalization data 52. After task 108, program flow returns.

Tasks 110, 112, 114, and 116 of process 102 are performed to allow a user to easily control an appliance. These tasks can be performed on a PDA, for example, which has a display and user input capability exceeding the user I/O capabilities typically found on appliances. In this case, an appliance is a service-receiving peer 20 while the PDA is a service-providing peer 20. During task 110, the service-receiving peer 20 uploads an appliance control computer program to the connected service-providing peer using the service connection. Next, during task 112 the service-providing peer 20 executes the just-uploaded computer program. Task 112 causes the service-providing peer 20 to become specifically configured to provide a desirable user interface for the specific appliance being controlled. Next, during task 114 control data are received at the service-receiving peer 20 over the service connection. The control data originated from user input is supplied through the control computer program being executed on the service-providing peer 20. After task 114, task 116 controls the subject appliance in accordance with the control data received in task 114. After task 116, program flow returns.

In summary, the present invention provides an improved capability addressable network and corresponding method. This network is suitable for interconnecting a plurality of everyday electronic devices, including movable and portable devices that provide a vast and diverse assortment of services. A priori activation and setup procedures are not required in this network because no network specific equipment requires network addresses in order to make connections. Although device addresses are not needed to establish connections, device names must be known by connected peers before meaningful communication can be established and information exchanged. In this context, a device or peer name is simply a unique identifier that allows one device or peer 20 to be uniquely distinguished from any other device or peer 20. Consequently, a minimal amount of user involvement is needed to make connections to peers, and peers may make connections to new peers as a routine matter. Network node

addressing is dynamically configurable because network connections are formed based upon proximity and upon a needs and capabilities evaluation rather than on unique network-wide address encoding.

Although the preferred embodiments of the invention have been illustrated and described in detail, it will be readily apparent to those skilled in the art that various modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

CLAIMS

What is claimed is:

1. In a capability addressable peer-to-peer data communication network, a method of establishing network connectivity comprising the steps of:

initiating a setup connection between first and second peers of said network;

evaluating needs and capabilities of said two peers; and

selectively processing a service connection in response to said evaluating step.

2. A method as claimed in claim 1 wherein said setup connection and said service connection are formed over a wireless communication link.

3. A method as claimed in claim 1 wherein said initiating step comprises the step of detecting, at one of said first and second peers, physical proximity of another of said first and second peers.

4. A method as claimed in claim 1 wherein:

said method additionally comprises the step of establishing first and second detection zones surrounding said first and second peers, respectively; and

said initiating step comprises the step of detecting whether said first peer is physically located in said second detection zone while said second peer is physically located within said first detection zone.

5. A method as claimed in claim 1 wherein:

said initiating step comprises the step of broadcasting an unsolicited need message from said first peer, said need message identifying said first peer and specifying a network service needed by said first peer; and

said evaluating step is performed at said second peer.

6. A method as claimed in claim 1 additionally comprising the step of performing an authorization process to determine whether said first peer is authorized to receive a network capability provided by said second peer.

7. A method as claimed in claim 1 wherein:

said method additionally comprises the step of providing a network capability available through said second peer to said first peer using said service connection; and

said network capability includes relaying, at said second peer, data communications between said first peer and a device in data communication with said second peer.

8. A method of operating a subject peer node in a capability addressable peer-to-peer data communication network comprising the steps of:

a) identifying physical proximity to other peer nodes operating in said network;

b) identifying an event which signifies a need for service at said subject peer node;

c) when said event has been identified and one of said other nodes has been determined to be proximate, establishing a setup connection between said subject peer node and said one of said other nodes;

d) receiving information describing a network capability provided by said one of said other peer nodes; and

e) forming a service connection between said subject peer node and said one other peer node when said capability information indicates a capability compatible with said need.

9. A method of operating a capability addressable peer-to-peer data communication network comprising the steps of:

a) detecting, at a first one of a service-requesting peer and a service-providing peer, physical proximity of a second one of said service-requesting and service-providing peers;

b) determining whether a need for a service connection exists at one of said service-requesting and service-providing peers;

c) establishing, if said determining step identifies said need, a setup wireless connection between said service-requesting and service-providing peers;

d) communicating authorization information describing said service-requesting peer to said service-providing peer;

e) determining whether to form a wireless service connection between said service-requesting and service-providing peers in response to said authorization information;

f) communicating capability information describing said service-providing peer to said service-requesting peer; and

g) determining whether to form said wireless service connection between said service-requesting and service-providing peers in response to said capability information.

10. A method as claimed in claim 9 additionally comprising the steps of:

forming said service connection when said service-requesting peer is determined to be authorized in said step e) and said service-providing peer is determined in said step g) to have a capability compatible with said need determined in said step b); and

providing said capability using said service connection.

11. A method as claimed in claim 10 wherein said providing step comprises the step of relaying, at said service-providing peer, data communications between said service-requesting peer and a device in data communication with said service-providing peer.

12. A method as claimed in claim 10 wherein said providing step comprises the steps of:

generating user output data at a first one of said service-providing and service-requesting peers; and

annunciating said user output data to said second one of said service-providing and service-requesting peers.

13. An apparatus for interactively coupling one appliance to another appliance into a network, said apparatus including in combination:

a receiver for receiving input data;

a transmitter for transmitting output data; and

apparatus for interactively coupling said one appliance to said another, said interactive coupling apparatus coupled to said receiver and to said transmitter to effect data communication therewith, said interactive coupling apparatus for:

initiating a setup connection between said one appliance and said another appliance of said network;

evaluating needs and capabilities of said one appliance and said another appliance; and

selectively processing a service connection in response to said evaluating step.

14. An apparatus as claimed in claim 13 wherein:

said interactive coupling apparatus additionally comprises means for establishing first and second detection zones surrounding said one appliance and said another appliance, respectively;

said initiating a setup connection between said one appliance and said another appliance of said network comprises means for detecting whether said one appliance is physically located in said second detection zone while said another appliance is physically located within said first detection zone; and

said first and second detection zones each define a wireless communication range of substantially greater than five meters.

15. A communications platform including a plurality of nodes, said platform comprising:

at least two nodes having overlapping communications regions; and

means for exchanging needs and capabilities information between said at least two nodes for forming a communication network.

16. A communication network method for establishing a personal area network comprising the steps of:

finding by a first communication node a second communication node which is compatible with the first communication node; and

automatically forming by the first and second communication nodes the personal area network.

17. A communication network method as claimed in claim 16, wherein the step of automatically forming includes the step of establishing a communication link between the first and second communication nodes when one of the first and second communication nodes determines that the first and second communication nodes are within a particular proximity.

18. A communication network method as claimed in claim 17, wherein the step of establishing includes the step of establishing a RF communication link.

19. A communication network method as claimed in claim 17, wherein the step of establishing includes the step of establishing a IR communication link.

20. A communication network comprising:

means for detecting, by a first node, presence of a second node which is proximate to said first node;

a communication link automatically established between said first and second nodes, said communication link established under control of said first and second nodes; and

means for determining by said first node whether said first and second nodes are compatible.

21. A communication network as claimed in claim 20, wherein there is further included means for alternately

routing said communication link by said second node to a third node, if said first and second nodes are incompatible.

22. An integrated circuit for interactively coupling one or more communication nodes in a common network, said integrated circuit including in combination:

a receiver for receiving input data;

a transmitter for transmitting output data; and

a processor, coupled to said receiver and transmitter for interactively coupling a first common node to a second common node, said processor including means for activating a communications link between said first and second common nodes when said first and second common nodes are within a predetermined distance from each other and when needs and capabilities of said first and second common nodes overlap.

23. A communication network method comprising the steps of:

finding by a first communication node a second communication node which is compatible with the first communication node; and

automatically forming, by the first and second communication nodes, the communication network without infrastructure.

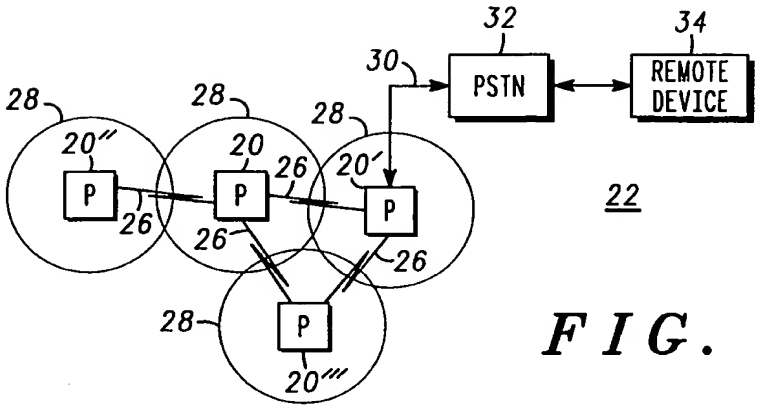
32
34
30
PSTN
REMOTE DEVICE
28
28
28
20''
20
20'
26
P
P
P
26
26
26
22
28
P
20'''

FIG. 1

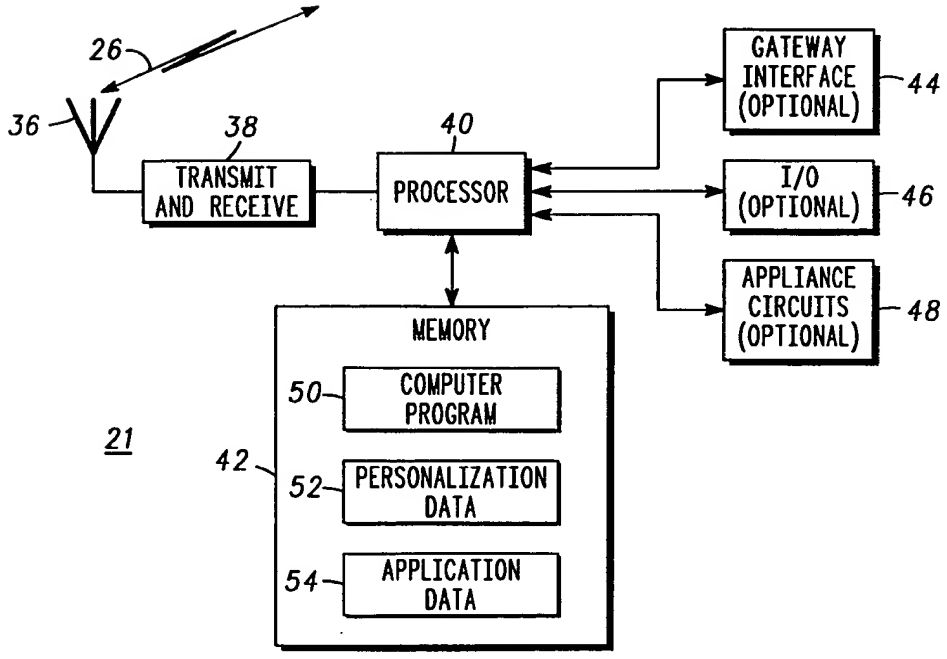
26
36
38
40
TRANSMIT AND RECEIVE
PROCESSOR
GATEWAY INTERFACE (OPTIONAL)
44
I/O (OPTIONAL)
46
APPLIANCE CIRCUITS (OPTIONAL)
48
MEMORY
50
COMPUTER PROGRAM
21
42
52
PERSONALIZATION DATA
54
APPLICATION DATA

FIG. 2

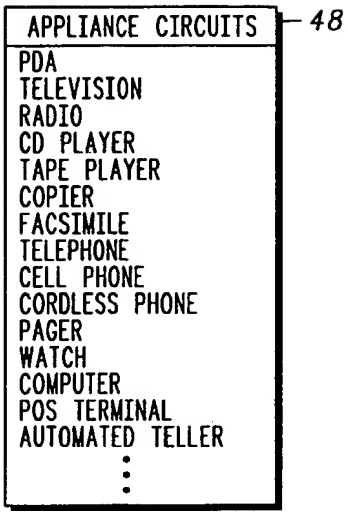

FIG. 3

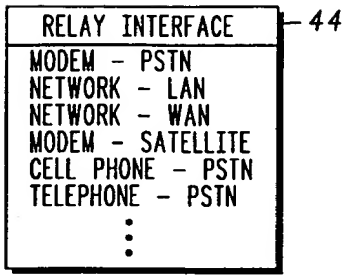

FIG. 4

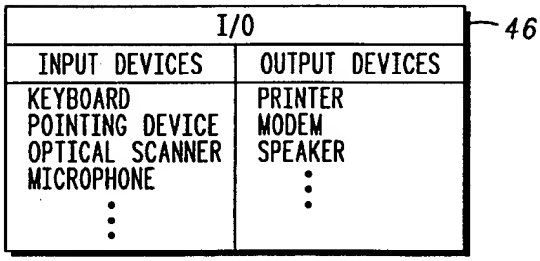

FIG. 5

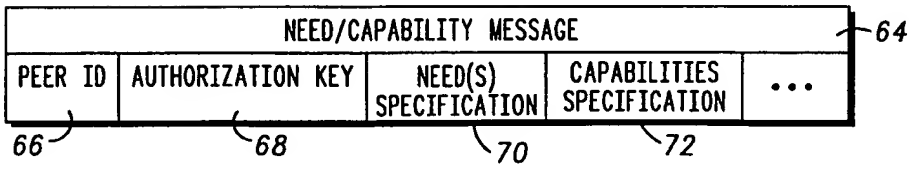

FIG. 7

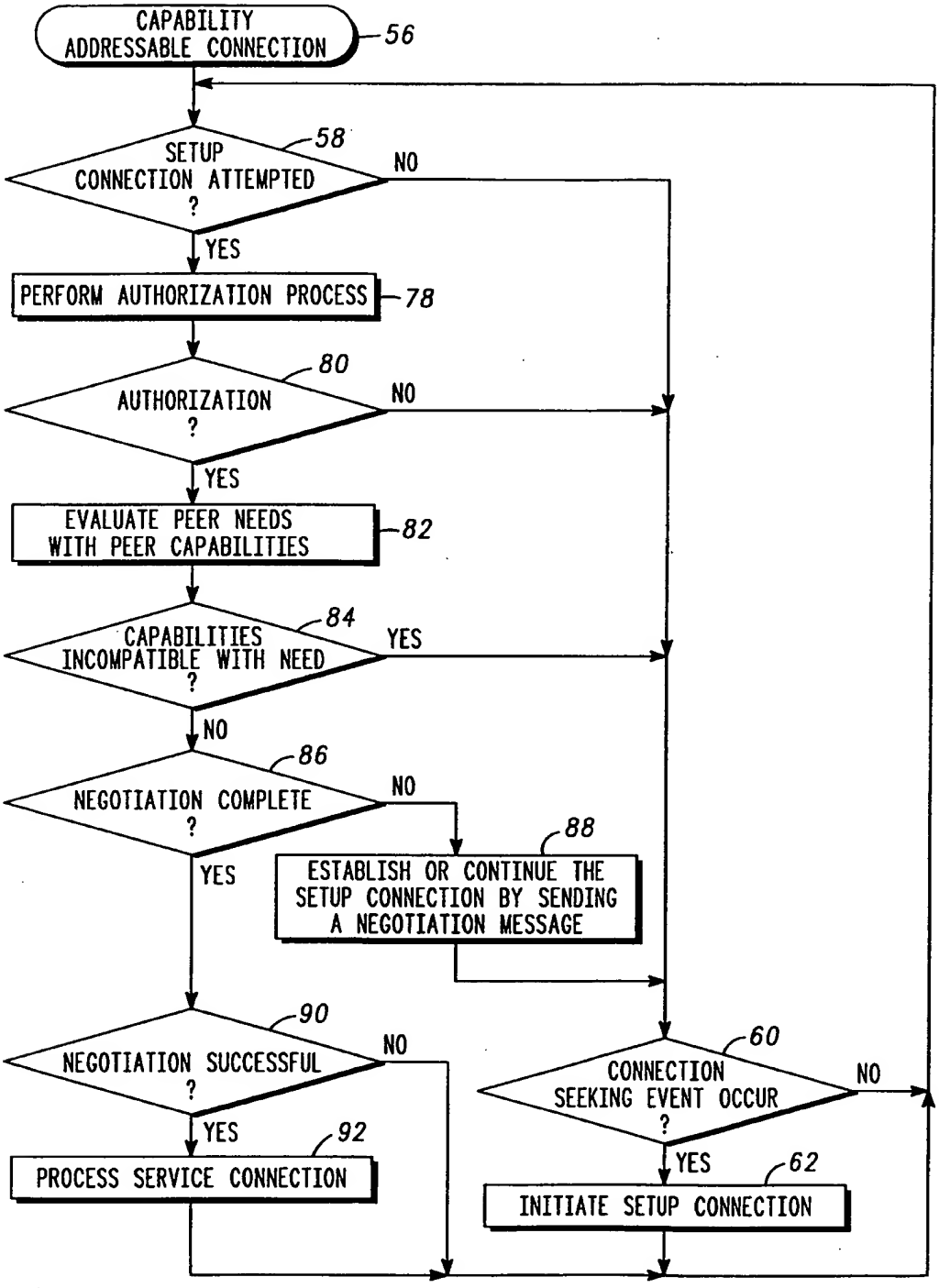
CAPABILITY ADDRESSABLE CONNECTION
56
SETUP CONNECTION ATTEMPTED ?
58
NO
YES
PERFORM AUTHORIZATION PROCESS
78
AUTHORIZATION ?
80
NO
YES
EVALUATE PEER NEEDS WITH PEER CAPABILITIES
82
CAPABILITIES INCOMPATIBLE WITH NEED ?
84
YES
NO
NEGOTIATION COMPLETE ?
86
NO
YES
ESTABLISH OR CONTINUE THE SETUP CONNECTION BY SENDING A NEGOTIATION MESSAGE
88
NEGOTIATION SUCCESSFUL ?
90
NO
YES
PROCESS SERVICE CONNECTION
92
CONNECTION SEEKING EVENT OCCUR ?
60
NO
YES
INITIATE SETUP CONNECTION
62

FIG. 6

NEED TABLE	
CODE	MEANING
—	APPLIANCE PERSONALIZATION (E.G., OWNERS NAME)
—	HARD COPY (E.G., PRINT)
—	VISUAL IMAGE (E.G., DISPLAY)
—	AUDIO (E.G., HIGH FIDELITY)
—	GATEWAY (E.G., INTERNET)
—	FINANCIAL TRANSACTIONS (E.G., POS, POINT OF SALE)
—	LOCK/UNLOCK (E.G., SECURITY ENABLE/DISABLE)
⋮	⋮

74

FIG. 8

CAPABILITY TABLE	
CODE	MEANING
—	APPLIANCE PERSONALIZATION (E.G., OWNERS NAME)
—	HARD COPY (E.G., PRINT)
—	MULTIMEDIA (E.G., REAL TIME VIDEO)
—	VOICE (E.G., SPEECH)
—	AUDIO (E.G., HIGH FIDELITY)
—	GATEWAY (E.G., INTERNET)
—	FINANCIAL TRANSACTIONS (E.G., POS, POINT OF SALE)
—	LOCK/UNLOCK (E.G., SECURITY ENABLE/DISABLE)
⋮	⋮

76

FIG. 9

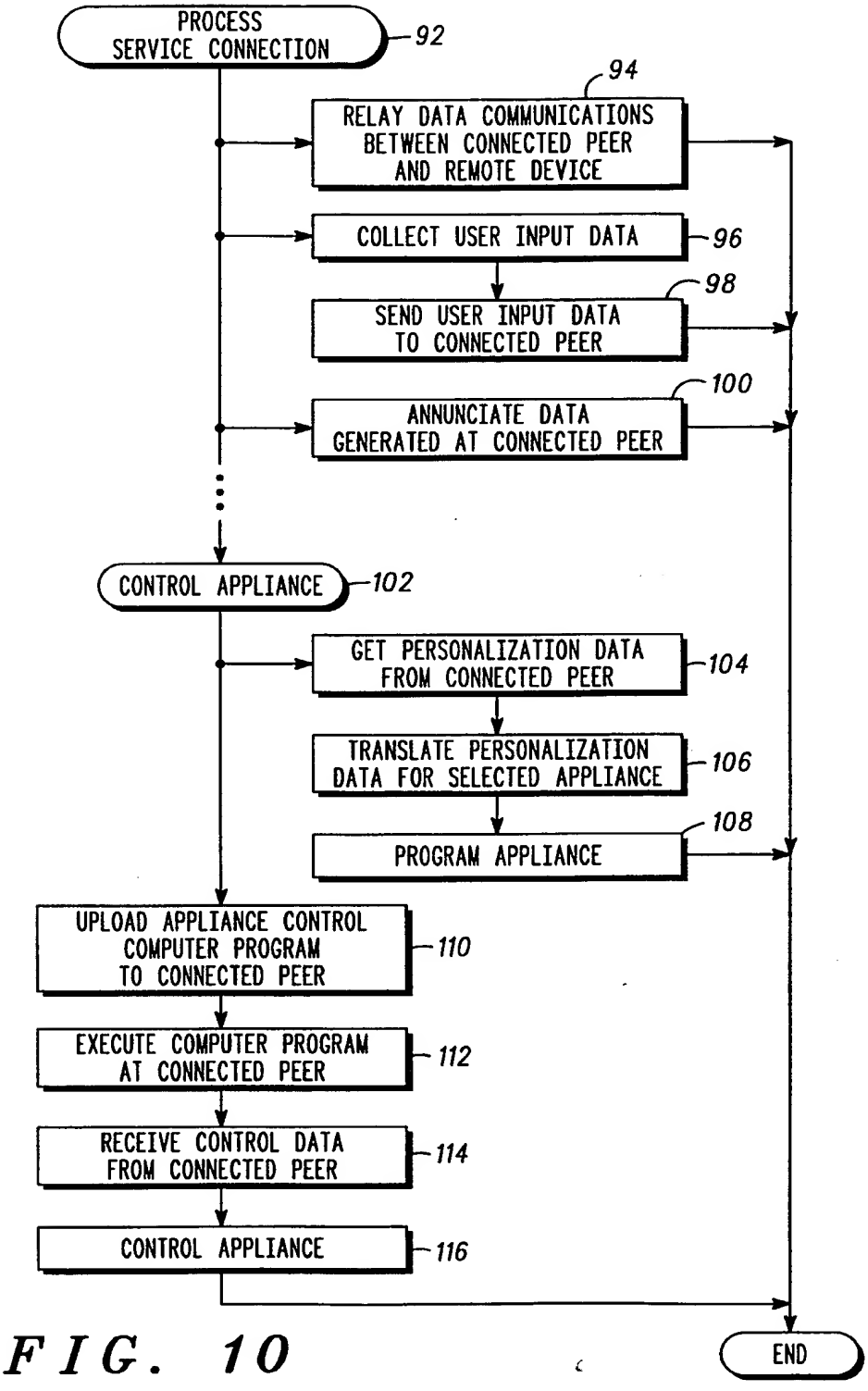
PROCESS SERVICE CONNECTION
92
94
RELAY DATA COMMUNICATIONS BETWEEN CONNECTED PEER AND REMOTE DEVICE
COLLECT USER INPUT DATA
96
98
SEND USER INPUT DATA TO CONNECTED PEER
100
ANNUNCIATE DATA GENERATED AT CONNECTED PEER
CONTROL APPLIANCE
102
GET PERSONALIZATION DATA FROM CONNECTED PEER
104
TRANSLATE PERSONALIZATION DATA FOR SELECTED APPLIANCE
106
108
PROGRAM APPLIANCE
UPLOAD APPLIANCE CONTROL COMPUTER PROGRAM TO CONNECTED PEER
110
EXECUTE COMPUTER PROGRAM AT CONNECTED PEER
112
RECEIVE CONTROL DATA FROM CONNECTED PEER
114
CONTROL APPLIANCE
116
END

FIG. 10

INTERNATIONAL SEARCH REPORT

Int ional Application No
PCT/US 97/16302

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04L12/28 H04Q7/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04L H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	WO 93 21715 A (ERICSSON TELEFON AB L M) 28 October 1993 see abstract see page 5, line 1 - page 9, line 8 see claims 1-5; figure 1 --- -/--	1,13,15, 16,23 2-4,6-8, 14,17,22 9-12, 18-21

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 November 1997	18.12.97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Cichra, M

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inte ional Application No
PCT/US 97/16302

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SCOTT K ET AL: "THE SELF-ORGANIZING WIRELESS NETWORK (SWAN) PROTOCOL FOR COMMUNICATION AMONG MOBILE USERS" GLOBECOM '95. IEEE GLOBAL TELECOMMUNICATIONS CONFERENCE, SINGAPORE, NOV. 14 - 16, 1995, vol. 1, 14 November 1995, INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, pages 355-359, XP000621510	1,2,13, 15,16,23
Y	see the whole document	20,21
A		3,4,14, 17-19,22

X	WO 96 04734 A (IBM ;IBM UK (GB)) 15 February 1996	16,23
Y	see abstract	2-4,7,8, 14,17, 20-22
A	see page 3, line 32 - page 6, line 41 see figures 1-4 see claims 1-23	1,9-13, 15,18,19

Y	ANONYMOUS: "ARIGO - A Peer-to-Peer Home Automation Network" IBM TECHNICAL DISCLOSURE BULLETIN, vol. 38, no. 9, September 1995, NEW YORK, US, pages 217-222, XP002047227	6
A	see the whole document	1-4, 8-16, 20-23

A	WO 94 15413 A (NORAND CORP ;MAHANY RONALD L (US); BUNTE ALAN G (US); LUSE RONALD) 7 July 1994 see abstract see page 1, line 1 - page 9, line 24 see figures 1-3 see claims 1-9	1-4,8, 10-16,23

A	ANONYMOUS: "Standard PC-NET Adapter and Software CSMA or CSMA/CA on Non-traditional Media." IBM TECHNICAL DISCLOSURE BULLETIN, vol. 35, no. 3, August 1992, NEW YORK, US, pages 105-108, XP002047228 see the whole document	1-4,8, 13-19,23

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int tional Application No
PCT/US 97/16302

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		NZ 251791 A	27-02-96
		SE 9304086 A	07-02-94
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		CZ 9603749 A	16-04-97
		EP 0772931 A	14-05-97
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		JP 8065303 A	08-03-96
		PL 318320 A	09-06-97
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